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CENTRAL INTELLIGENCE AGENCY  
INFORMATION REPORT

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COUNTRY USSR

SUBJECT Evaluations of a Book on Oxide and Phosphate Coatings and use on Isochromatic Lines in Metals Under Stress

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SUPP. TO  
REPORT NO.

1. A.M. Yampolskiy\*: Oxidizing and Phosphating of Metals. Original Russian edition Moscow-Leningrad (1950). German translation Leipzig (1953). 71 pp.  
\*transliterated in German by A.M. Yampolski.
2. "How to" book covering
  - a. 1. Oxide coatings for iron and steel; aluminum and aluminum alloys; magnesium, copper, zinc and other nonferrous metals and alloys
  2. Phosphate coatings for ferrous and nonferrous metals and alloys
  3. Oxide-phosphate coatings for iron and steel
- b. No equivalent book in English is known although chapters on these subjects are contained in various handbooks and similar articles have appeared in technical and trade magazines. Yampolskiy's book, however, is characterized by its great simplicity. Every step of each method is outlined in such detail that almost any workman should be able to follow the instructions without difficulty.
- c. Among the omissions noted:
  1. The steam process, which has found considerable use in the USA for forming an oxide coating on iron and steel alloys, is not mentioned.
  2. There is no indication that an electrolytic process for surface treatment of magnesium alloys similar to Frankford Arsenal's HAE process was being used in the USSR in 1950.
  3. Iron, zinc and iron-zinc phosphate coatings are used in the USA in addition to the various types mentioned by Yampolskiy, who places major emphasis on the manganese-iron phosphate process\* although other modifications (notably those including zinc) are also listed as "accelerated" methods.

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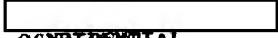
4. Yampolskiy merely hints at the use of phosphate coatings for resistance to scuffing and wearing, particularly during the break-in period. This application is particularly common in the automotive industry in the USA.
5. The shortest phosphating time mentioned by Yampolskiy seems to be five minutes. Even faster methods requiring as little as one minute are used in the USA although they do not give maximum corrosion resistance.
6. Except under magnesium alloys where "organic solvents" are mentioned, organic degreasing media other than alcohol, gasoline and benzene apparently are not used. Most of the degreasing media appear to be alkaline solutions. In the USA such use is made of special organic degreasing media, such as carbon tetrachloride, trichlorethylene and Stoddard's.
7. Salt spray as a test is not mentioned. High considerable use appears to be made of 3% sodium-chloride solution at room temperature.

d. Among the new processes:

1. While details of the Cromak process are given, a dip method based on a nickel sulfate-ammonium sulfate-zinc sulfate solution is said to be "far more reliable"; and chemical oxidation of zinc is claimed to be "best for corrosion resistance". As far as is known, the latter two methods are not being widely used-if at all-in the USA; although chromate coatings such as the Cromak process are used to a considerable extent, as are phosphate coatings, which Yampolskiy mentions elsewhere.
2. As far as is known, no electrolytic phosphating method is used commercially in the USA. While Yampolskiy states the direct-current electrolytic process is experimental, he indicates that the alternating-current method is being used in the automotive industry in the USSR.
3. Chapter V treats at length an oxide-phosphate process developed by Cahn, where the coating consists of calcium or barium phosphate and iron oxides. Bilfinger in the introduction to the German edition states that this process is still relatively unknown in (East) Germany. As far is known, a process of this type is not used in the USA, although a number of the oxide and phosphate coating processes are proprietary, so complete details of their composition are not available. Most of the advantages listed for this oxidiphosphate method relate to oxidizing methods for iron and steel; the reason for its purported superiority to phosphating are not clear.
- e. The 20 references are predominately Soviet. It must strike the Germans as rather odd that the many German articles in this field are not mentioned; for example, there is not a single reference to W. Machin, probably the most widely known German authority in this field. It is perhaps for this reason that Bilfinger in his introduction to the German edition writes that Yampolskiy has deliberately omitted literature references for the various methods described.

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3.

2. S.I. Bugkin and S.I. Dobrovolskiy: Investigation of Isochromatic Lines in Transparent Models Undergoing Permanent Plastic Deformation. Doklady Akademii Nauk SSSR 88 (1953) no. 5, pp 799/802

a. In transparent models, stressed elastically and observed under polarized light, the isochromatic lines signify the positions of equal normal stresses. The authors had previously observed similar isochromatic lines when such models were stressed plastically and had proposed that these lines denoted equal shear stresses. Comparative tests were therefore made with four types of transparent materials, stressed both elastically and plastically.

1. The stress pattern changed very little on transition from the elastic to the plastic range.
2. The pattern was similar in all the cases studied regardless of the type of material and type of deformation.
3. Differences in the stress pattern of the various types of material may be ascribed first of all to the effect of residual stresses, which are different for different materials.
4. Of the four materials studied, only the silver chloride favored the formation of residual stresses of all three orders; the other materials gave only residual stresses of the first order.

To study the stress distribution in polycrystalline metals during plastic deformation, transparent models of amorphous, very plastic material should be used to get a regulated distribution of stresses following the laws of plasticity. In some cases it might be useful to determine the stresses also in an elastic-plastic material, which will permit appreciable elastic deformation.

- b. Photoelasticity is one of the older methods of studying stress distribution. In general, however, its use has been confined to the region of elastic behavior.

M. Hetenyi: Stresses in Rotating Parts. Metal Progress 39 (1941) pp 200/201

C. Berger and T.W. Buckwalter: Improving engine axles and piston rods. Metal Progress 39 (1941) pp 202/206

W.M. Murray: Seeing stresses with photo-elasticity. Metal Progress 39 (1941) pp 195/200, also Stress Analysis Methods-Choice Determined by Part's Design and Application. Materials & Methods 23 (1946) pp 1002/1006, also Measurement of Surface Stresses. Surface Stressing of Metals. ASM (1947) pp 19/32

B. Segarman: A Photoelastic Approach to Stress Modifications Caused by Inhomogeneities. Symposium on Internal Stresses in Metals and Alloys. The Institute of Metals (1948) pp 281/286

- c. Bakelite and celluloid are perhaps the most common materials for photoelastic models but the idea of using silver chloride is not new. As a matter of fact, Nye used it for very similar purposes to those of Bugkin and Dobrovolskiy, namely for the photoelastic investigation of plastically deformed material.

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4.

The present paper does not cite Nye; it is not known whether the 1950 paper by Gabkin and Dobrovolskiy includes Nye as a reference.

K.L. Petters and M. Dieses: Silver Chloride as a Medium for Study of Ingot Structures. TAIPE 154 (1943) pp 262/272; disc 273/274.

J.F. Nye: Photo-Elastic Investigation of Internal Stresses in Silver Chloride Caused by Plastic Deformation. Nature 161 (1948) pp 367/368

- a. Gabkin and Dobrovolskiy-as judged by this paper and the title of their 1950 paper-are apparently most interested in the working of metals. The present paper at least does not consider the basic question, namely which of the transparent materials gives stress distribution most similar to those found in the metals involved.

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